

QUARTERLY PROGRESS REPORT

DRD 875MA-003

April 2003 – June 2003

**Marshall Space Flight Center
Safety and Mission Assurance Mission Services Contract
NAS8-00179**

Approved:

Original Signed By:

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1.0 INTRODUCTION

Hernandez Engineering, Inc. (HEI) successfully performed all required activities and tasks, as described in this report, in fulfillment of their Safety and Mission Assurance (S&MA) Mission Services Contract (NAS8-00179) with NASA's Marshall Space Flight Center (MSFC). This report covers a three-month period of the contract's third quarter of the second option year: April 2003 through June 2003.

2.0 GENERAL MANAGEMENT

2.1 Data Requirements

The third quarter of the second option year of the S&MA Mission Services contract was successfully completed on June 22, 2003. All Data Requirements (DR) Documents were submitted on or ahead of schedule throughout the quarter. They included DRD 875CD-001 On-Site Employee Location Listing; DRD 875MA-002 Financial Management Reports; DRD 875MA-003 Progress Reports (Monthly/Quarterly); DRD 875MA-006 Operations Plan, Problem Assessment Center (PAC); DRD 875MA-007 Quarterly Open Problems List; DRD 875MA-008 Monthly Newly Opened/Closed Problem Summary; DRD 875SA-002 Mishap and Safety Statistics Reports; and Quarterly Safety Performance Evaluation.

2.2 Personnel Status

(b)(4)

3.0 BUSINESS MANAGEMENT

We have experienced no financial or business management problems during this period. We attribute this to close attention to details, effective use of established controls designed to efficiently respond to program changes---both anticipated and unexpected---and the continuing support of our corporate financial group's dedicated efforts at controlling overhead expenses.

The contract continues to have a total cost underrun at the end of this period---see the June 2003 Monthly Financial Report, DRD 875MA-002, for specifics. Attachment 2, Man-Hours Expended, of this report contains a description, by major task, of the total man-hours expended this period. ~~2~~

(b)(4)

4.0 PERFORMANCE OF WORK AND USE OF FACILITIES AND EQUIPMENT

4.1 Safety

4.1.1 Industrial Safety (IS)

The Industrial Safety (IS) group performed 84 OSHA compliance annual facilities inspections and provided all required reports in a timely manner. Also, IS performed 585 construction site compliance inspections to monitor adherence to OSHA and MSFC safety standards. All facility safety violations were documented in the HAZTRAK databases in order to assure MSFC's compliance with OSHA, NASA, and other consensus code requirements.

Among other activities, IS: (1) updated three facility fire evacuation plans; (2) participated in two pre-construction conferences; (3) participated in 12 final safety inspections of facilities under renovation or construction; (4) reviewed 82 sets of facility design drawings for compliance with OSHA and consensus

codes; (5) participated as an instructor on identification of hazards in the workplace for one training class for Building Managers and Their Assistants; (6) assisted QS50 develop and process, for web page posting, eight safety bulletins and three Shop Talk safety information topics; and, (7) performed 20 annual fire drills.

Regarding the assigned Area of Emphasis to increase awareness of identifying Unsafe Acts in the workforce, IS identified 15 Unsafe Acts with emphasis on on-the-spot corrections. In addition to identifying unsafe acts, IS prepared a draft article for the Center Directors corner of the Marshall Star addressing the importance of all civil service and contractor supervisors to increase vigilance in identifying the unsafe acts that occur in their respective work places. As part of this requirement, HEI self-initiated the return of (b)(4) to assist the Industrial Safety Department (ISD) identify Unsafe Acts. In support of a MSFC special area of emphasis, this experienced safety expert also assisted ISD perform a survey of maintenance and construction activities to assure adherence to Lockout/Tagout requirements when working on energized systems. The survey included monitoring of construction and maintenance activities after normal work hours, to include weekends.

IS continued to provide (b)(4) to assist the SHE Communications and Training Teams and general communication of safety awareness to all MSFC employees. Assistance included: (1) wrote several safety articles for publication in the Marshall Star; (2) prepared and processed, for web page posting, the weekly SHE highlights and monthly SSWP safety required and optional focus topics; (3) prepared monthly SHE communications plans; (4) developed multiple innovative safety awareness communications materials including safety announcement on MSFC TV; (5) assisted QS50 complete an extensive rework the NASA Performance Evaluation Profile (PEP) refresher training module in preparation for the annual PEP; (6) prepared numerous draft letters of appreciation for the S&MA Directors signature; and, (7) prepared numerous safety handouts for the Safety Fair at Madison.

IS initiated, completed or followed-up on more than twenty hazard analyses. Examples included: (1) completed numerous draft safety assessments (SA) to include the SA for the Bolt Catcher test in building 4619; (2) continued to perform a SA for the high visibility Propulsion Research Laboratory (PRL), now under construction; (3) continued to support the testing on the Northrop Grumman Composite (NGC) Sub-Scale Cryotank; and, (4) supported the testing for the 24-Inch Motor firing.

IS continued to support the implementation of the NASA lifting standard, NASA-STD-8719.9 by providing day-to-day advice and assistance to S&MA customers. In addition to reviewing the OHA for the GP-B, IS served as the safety monitor for the Pathfinder/on-site move of the GP-B from Moffet, CA to Vandenberg, CA. Also, HEI advised civil service and contractor managers, supervisors and employees on requirements for lifting equipment proficiency testing in support of the MSFC Personnel Certification Program. As a new task, HEI agreed to assist S&MA/QS50 develop and implement a plan for HEI to administer proficiency exams to contractor operators, as well as civil service operators of overhead cranes, fork lifts, small truck mounted hoists, and aerial lifts.

As a continued significant strength, IS continued to provide dedicated, full-time safety and quality support to the MSFC Test areas. Examples of support included: (1) participated in the TRR's for the 24" Solid Rocket Motor and the Bipod Faring Redesign Thermal Panel Development test; (2) reviewed explosives siting Quantity-Distance calculations for numerous test to include the 24" Motor and the NGC subscale Cryotank test; and, (3) provided daily support to test engineers and S&MA personnel on technical issues to include performing numerous test procedure reviews.

4.1.2 System Safety Engineering

System Safety Engineering (SSE) provided Computer Aided Fault Tree Analysis (CAFTA) support to the Shuttle Systems Contingency Team analyzing the STS-107 mishap. SSE facilitated the team's fault tree development to direct and document their analysis efforts. Safety Engineering also provided consultation, regarding the CAFTA software capabilities, to the External Tank and Reusable Solid Rocket Motor Contingency Teams.

In support of the investigation for the External Tank (ET), Project Assurance Specialist developed matrices for each primary branch of the ET fault tree that related ET Hazard and CIL codes and Integrated Hazard codes to the appropriated fault tree blocks.

The ET team met, reviewed, and created the Return-To-Flight (RTF) Action Matrix. The matrix is comprised of specific Marshall S&MA actions and the Program Requirements Control Board Directives (PRCBD) that will be continuously updated and reported to Marshall Management, ET Project, and LMC Management.

ET SSE coordinated and reviewed the PDR package on the Bipod Redesign. The ET Assurance Team divided the document by volumes to coordinate all disciplines. The Team, reviewed page-by-page the 208-page document compiling questions and concerns. The ET Assurance Team wrote 51 Review Item Discrepancies (RID) and Review Comment Actions (RCA) against the PDR Package as a result of the review. ET System Safety participated in the formal PDR at the Michoud Assembly Facility (MAF) the week of 6/16/03.

ET SSE traveled to MAF for two days of interface meetings with the ET Contingency Working Group and participated in the dissecting of a High Fidelity Bipod Model. SSE is supporting multiple ET RTF activities including participation in Tiger teams and extensive travel to the MAF for the foreseeable future.

SRB SSE investigated an issue that was a possible constraint to launch. MSFC testing revealed that similar ETA ring material properties were insufficient to provide the required 1.4 factor of safety. A waiver was submitted to fly in the as built configuration. The ETA ring solution approach was presented to the ICB and PRCB and was well received. SRB Project is working with the CAIB to answer concerns.

SRB SSE supported a teleconference addressing an issue discovered at the FIV vendor MOOG. During a routine visual inspection after a successfully completed confidence test performed pre-ATP, damaged threads with a foreign material were discovered on the FIV manifold. MOOG has inspected 11 other FIV manifolds and found no discrepancies. The issue was discovered 6/5/03, there will be more to come.

RSRM SSE is supporting RSRM Return to Flight meetings: Thiokol's System Safety Action Plan Team, RTF Planning Team, PRCB, and MSFC/Thiokol Chief Engineering RTF Team. Thiokol's System Safety, MSFC Engineering, and MSFC System Safety evaluated 9 out of the 22 RSRM "accepted risk" for potential debris, compliance with NSTS 22254, adequacy controls/audits, and identification in the 4x3 risk matrix. Work is incomplete, but no discrepancies have been identified.

RSRM Systems Safety created a matrix evaluating the RSRM Hazard Reports failure causes (over 1100 of them) with the RSRM Investigation Working Group's Fault Tree, and presented our findings to the RSRM Investigation Working Group. S&MA is updating the matrix to incorporate necessary additions and corrections.

RSRM SSE witnessed the removal of two actuator brackets that resulted in some damage to the Aft Exit Cone (AEC) threaded holes. Discussion focused on testing to accurately determine the actual safety

factor for refurbished AEC. Progressive damage has been noted by bolt holes enlargement and thread pitch diameter enlargement with each refurbishment. The cause is still being investigated. The long-term plan is to investigate redesigning the AEC and compliance ring so that, there will be more thread engagement (safety factor above the CEI requirement of 1.4) on both units even after refurbishment.

RSRM SSE supported a TIM to discuss test failures of ETM-3's Chemlock witness panels. Thiokol's assessments uncovered five contributing factors to witness panel failures. None of these are critical by themselves, but in combination can cause failure of the case/insulation bond line. Thiokol has presented approaches to minimize the effects of each of these five causes. MSFC technical experts will continue Chemlock testing/evaluating here, and share their results with Utah's Thiokol.

SSME SSE clarified the proposed SSME hazard analysis RTF effort that was presented by Rocketdyne at the SSME chief engineers' teleconference on 05/30/03. SE also evaluated and commented to draft charts for Rocketdyne's presentation of the same topic to the PRCB on 06/03/03. SE supported the hazard analysis RTF action item closeout portion of the 06/05/03 Space Shuttle PRCB teleconference to gain an awareness of what the other Shuttle element projects have proposed for RTF, plus the PRCB's responses to their presentations.

SSME SSE reviewed the presentation material in advance, participated in the teleconference on 06/18/03, and noted to the MSFC S&MA SSRP representative a concern regarding some KSC data systems supporting review of new CILs by the SSRP. Follow-up actions indicated that there was no need for concern, and the CILs were recommended for approval without additional comments from MSFC.

SSE participated in the Test Readiness Review (TRR) for the X-37 Approach and Landing Test Vehicle (ALTV) Proof Test. SSE represented MSFC S&MA in the Test Area Safety Walk-through.

SSE tabulated previous baseline 2GRLV S&MA requirements to compare against suggested initial OSP Level II requirements in preparation for planned project level discussions. Requirements were copied into a new database to assist in tracking the development of OSP Level II requirements.

SSE reviewed OSP Level I requirements, Draft Human Rating requirements, and agency requirements to develop a set of safety and mission assurance Level II requirements. Efforts continue to document requirement flows from Level I or agency requirements to the proposed Level II requirements. A matrix is being designed to track requirements.

SSE participated in the TIM on 6/27-30/03 at JSC to define the OSP SRD requirements. SSE supplied the safety rationale for requirements, evaluated new requirements and presented requested data to support the proposed availability requirements. The OSP Requirements Office accepted the action to request OSP management and determines the correct limits for availability based on the historical data presented and OSP Program goals. S&MA accepted an action to submit a requirement for prevention of failure propagation.

SSE participated in the SRD Development Off-site OSP meeting at the Marshall Institute 6/10-12/03. Comments submitted by the major contractors were discussed and dispositioned the first day. Contractor representatives were given the opportunity to discuss the requirements and comments in an open forum. NASA provided disposition of all comments during the meeting. Several actions were assigned to the requirements working group. All actions assigned to the S&MA Team were resolved by 06/18/03.

PSE gathered information and generated closure statements for all open verification closure notices (VCN's) on Node 2. These items were submitted and signed except for two that will remain open until the Non-compliance report (NCR) on extravehicular activities (EVA) kick loads is approved.

SSE closed all open verifications for Node on the ground safety verification tracking log (SVTL) and provided this closure information to KSC Ground Safety Review Panel (GSRP). All signatures were received on the ground hazard reports from Alenia and Boeing.

PSE supported the successful completion Node 2 Ground Safety Review by updating and submitting the Node 2 Ground Safety Data Package (GSDP) to the KSC ground safety review panel, presenting and coordinating the review presentations to the GSRP. The hazard reports (7) were presented and approved with minor comments. All hazard reports and certification letters have been signed by the GSRP.

PSE presented the NCR's on Ammonia Fittings procured as non-fracture critical items and the kickloads causing negative margins on the meteoroid debris panels. The SRP stated that the kickload NCR needs to be presented to the Extravehicular Activities board prior to presentation to the SRP, and the Ammonia fitting criticality is to be covered in the hazard report and does not require a separate NCR.

PSE supported the ARB meeting via teleconference. The ARB accepted the Node 2 stating it was the most complete module that has been received for processing at KSC and congratulated the entire Node 2 team for a job well done.

PSE continued update of the Solar-B Hazard Analysis. PSE provided review and comment to Lockheed Martin documents: SOLAR-B Focal Plane Package (FPP) Sub-System Hazard Analysis (SSHA); FPP Failure Modes and Effects Analysis; FPP Handling and Transportation Plan and Gravity Probe -B Phase III Flight Safety Data Package & the Phase III GSDP.

PSE provided a copy of the MPLM Programmable Thermostat Phase III hazard analysis to the Payload Safety Review Panel (PSRP) and the GSRP.

PSE received comments from the preliminary thermostat hazard analysis sent to the PSRP. A preliminary response to these comments has been generated and is in the process of being reviewed by the MPLM Project. Updates are also being made to the MPLM Programmable Thermostat hazard analysis.

SSE reviewed and commented to the S&MA portion that has been integrated into the DART Project Plan and the FMEA/CIL.

SSE participated in the Demonstration of Autonomous Rendezvous Technology (DART) Mission Unique Critical Design Review (MUCDR). Safety illuminated several issues with a lack of either maturity and/or detail during the MUCDR. SSE suggested several areas to be closely followed by MSFC S&MA to ensure issues are satisfactorily resolved.

SSE supported the DART Design Certification Review (DCR). SSE recommended to the S&MA Lead that RIDs be written against the packaging, handling, and shipping requirements in the Systems Requirements Document based on a lack of maturity and specifics. It has been recognized that these are deficient and the contractor has agreed to update after receiving all comments from the DCR.

SSE represented MSFC S&MA at the DART Mission Integration Working Group (MIWG) #3 meeting held June 19-20, 2003, at VAFB. SSE was involved in the discussions concerning hardware status, VAFB support abilities and facilities, communication and telemetry, and flight readiness review procedures. System Safety chaired the safety splinter group that also included KSC ELV Launch Services, OSC Safety, and VAFB Safety representatives. The entire agenda, including VAFB comments concerning requirements of EWR 127-1, was discussed in detail. Agreements were made to ensure that all safety issues are satisfactorily addressed and communicated to all parties in a timely fashion.

Project Assurance Specialist supported the safety-working group by reviewing and commenting to latest draft of the new revision of S/W Safety Standard, STD-8719.13B.

PSE in support of the BIC program coordinated the update, approval and submittal of Certificate of Payload Safety Compliance for the PCG-STES/DCAM payload onboard the ISS 11A mission.

PSE has completed the Fault Tree Analysis for the Delta-L project, closing one of the teams Action Items. The team will review and update the project risk.

PSE is working on completing the final draft of the Phase III Flight Safety Data Package for the Delta-L, the Hazard Reports and the Safety Verification Tracking log.

SSE supported the TIM between Technospazio and NASA JSC Payload Safety Review Panel (PSRP). The TIM was conducted to allow Technospazio to determine the key safety issues in the development of the Europa payload, which is designed to function on the Express Pallet, which will be mounted externally to the International Space Station. System Safety provided comments to the package presented via teleconference during the TIM.

SSE submitted the final Safety Verification Tracking Logs (SVTL) (both flight and ground) to the PSRP after completion of all ground processing at KSC. G-LIMIT has been turned over for stowage, and launch on ULF-1.

PSE participated in the Pre-Ship/Acceptance Review follow-up actions, including final submittal of the Certification of Payload Safety Compliance form, and final coordination of the Safety Verification Tracking Logs (SVTL) (both flight and ground) with the PSRP. G-LIMIT has been turned over for stowage, and launch on ULF-1.

SSE participated in the MGM Pre-Ship/Acceptance Review follow-up review, which were successfully completed.

SSE is working the resolution of comments to the phase II MSRR-1 GSDP from KSC. Initial response was made to KSC, and a teleconference to address the KSC comments is planned following the July 4th holiday.

PSE submitted the MSFC managed Protein Crystal Growth (PCG) Single Thermal Enclosure System (STES) with Protein Crystallization for Microgravity (PCAM) STS 114 / ISS ULF-1 mission payload flight and ground Safety Compliance Data Packages (SDPs) to the PSRP and the GSRP. The PSE coordinated comments from the GSRP to the SDP and closure of open Verification Tracking Log items.

SSE produced System Safety assessment charts for the ProSEDS Pre-Ship Review. The Pre-Ship Review was scheduled for 02/20-21/03.

PSE is working with the TES team on the closing methods of the safety verifications. The Phase III Safety Review has been scheduled for 08/11/03 – 08/12/03.

PSE reviewed the Vapor Compression Distillation (VCD) Flight Experiment (FE) as requested. The results of this review were submitted to S&MA. Payload Safety also provided S&MA some historical information of previous Columbia upgrades from information taken from a book on the Space Shuttle History or the first 100 flights. This information also included a presentation on the Micro-Meteoroid Orbital Debris (MMOD) Wing Leading Edge Sub System (LESS) Protective Shield Study.

4.2 Reliability

4.2.1 Reliability & Maintainability Engineering (R&ME)

In support of the Advanced Projects Assurance Department, R&ME continued providing R&ME discipline support to the Orbital Space Plane (OSP) and Next Generation Launch Technology (NGLT) programs. R&ME continued to participate in the development of the OSP level 2 requirements and began providing R&ME support to the OSP vehicle architecture contractors. This includes establishment and participation in an R&ME Vehicle Working Group to identify and resolve R&M related issues with the three architecture contractors. Additionally, R&ME supported development of the OSP RMS Engineering Plan.

R&ME reviewed the X-37 Approach and Landing Test Vehicle Failure Modes and Effects Analysis (FMEA) and provided extensive comments to the contractor for incorporation. R&ME participated in the X-37 Orbital Flight System (OFS) System Requirements Review (SRR) to ensure that the appropriate R&M requirements were developed and specified in the X-37 System Specification. R&ME reviewed the first draft of the X-37 Reliability & Maintainability Program Plan that was submitted for the X-37 SRR and determined the plan to be unacceptable as it did not provide sufficient detail on the implementation of the required R&M program tasks. R&ME is working with X-37 project office and Boeing to ensure that an acceptable R&M Program Plan is in place by the System Design Review.

R&ME continued to work with the DART program prime contractor to ensure that concerns regarding the DART FMEA and reliability analysis are appropriately resolved.

In the NGLT arena, R&ME has been an active participant in the RS-84 RMS team meetings and participated in the RS-84 Engine Preliminary Design Review and splinter sessions held with Boeing R&M personnel. R&ME also began supporting the NGLT Life Cycle Analysis Team (LCAT) and has received several actions from the NGLT lead, including development of a data dictionary for the LCAT System Breakdown Structure.

During this period, R&ME also began supporting the Jovian Icy Moon Orbiter (JIMO) project, and is participating in the planning and development of a number of risk reduction activities, including FMEA and PRA.

In support of the Shuttle Assurance Department, R&ME continued to support the STS-107 accident investigation activities by researching and analyzing FMEA/CIL and Hazard Report data for each of the propulsion elements, preparing and presenting summary materials, supporting development of the fault tree analyses, and other requests as directed. R&ME is currently actively involved in Return To Flight activities for all of the propulsion elements. Additionally, R&M continues to support ongoing effort related to Shuttle Upgrades, including active participation in the ET friction stir weld process implementation, as well as in the qualification process for the SRB Command Receiver Decoder and Altitude Switch Assembly. R&ME participated in a product-process audit of the SRB range safety batteries performed at BST Batteries manufacturing facility. R&ME participated in an SSME Reliability & Safety face-to-face meeting at KSC with a primary goal of improving center-to-center communications.

In support of the Cargo Assurance Department, R&ME continued program coordination of verification closure documentation to support the Node 2 requirements verification and Final Acceptance Review activities. R&ME continued development of the Node 3 FMEA/CIL and provided the initial Node 3 FMEA/CIL and Maintenance Crewtime submittals to ISS R&ME for program review and coordination. R&ME participated in a Regenerative ECLSS Availability Technical Interchange Meeting (TIM) to coordinate reliability source data for the Regenerative ECLSS ORUs. As a result of the TIM, R&ME

received several action items to reassess reliability data for some of the ECLSS components. R&ME completed development and coordination of the FMEA for the MPLM shell heater programmable thermostats that are being developed in-house by MSFC. R&ME prepared a fault tree in support of the Quench Module Insert (QMI) project Thermocouple Failure Anomaly Resolution.

4.2.2 Problem Assessment Center (PAC) Operations

HEI's PAC personnel processed and coordinated disposition of problem reports, coordinated the MSFC Problem Assessment System, supported the Columbia accident investigation, performed various return-to-flight activities, and operated the Corrective Action System (CAS). The PAC received and entered 1 new problem report (PR) into MSFC's Problem Reporting and Corrective Action (PRACA) System, coordinated MSFC interim closure of 5 PRs, received 3 prime contractor closure recommendations, supported MSFC full closure of 4 PRs, coordinated non-problem closure of 0 problems, and performed 217 individual PR database updates and reviews – mostly associated with the SSME Chief Engineer Action 2 (CE-2) Return-to-Flight activity. The PAC conducted 2 SSME problem review boards (PRBs) resulting in the disposition of 7 of 7 problem reports presented. The PAC generated or updated trends for all SSME, RSRM, and SRB problems submitted as newly opened or for closure. The PAC also generated and distributed monthly problem bubble trend risk charts (including active problems status, ages, and raw and moving average new problems over the last 13 months) and briefed them at the monthly SRB Problem Assessment System (PAS) review. The PAC reviewed 5 requests for access to the MSFC PRACA database and granted 4 of them.

In support of follow-up to the STS-107 Columbia accident, the PAC performed various data history searches regarding In-Flight Anomalies, KSC PRACA problems, and MSFC PRACA issues; assisted in staffing the S&MA Action Center; supported S&MA in preparation for Columbia Accident Investigation Board (CAIB) briefings; and coordinated MSFC S&MA participation in NASA Accident Investigation Team (NAIT) teleconferences – distributing discussion charts, taking meeting notes, and distributing the notes along with an overview of significant teleconference discussions.

In problem system coordination, the PAC conducted 1 SRB Problem Assessment System (PAS) status review for the SRB Chief Engineer and other SRB Project and S&MA personnel and offered redlines regarding proposed changes to the SSP 30223 PRACA Requirements. As a part of the SSME CE-2 activity, the PAC reviewed 8 years of SSME PRACA problems for accuracy of Failure Mode Effects Analysis (FMEA) assignments, and updated over 144 of them. The PAC also met with the SSME prime contractor in California to discuss the PRACA review and worked together to come to a common understanding of resources, data systems, and categorization approaches.

The PAC provided various problem data in support of NASA and MSFC analyses. Regular activities included providing daily KSC PRACA shuttle problem summaries, daily MSFC PRACA open-against-next-mission summaries, daily KSC Resident Office reports, monthly HEDS new shuttle problem charts, monthly newly opened/closed problem summaries, weekly SRB PRACA and ALERT status reports, and quarterly Open Problems List (OPL). Special activities included: (1) providing the SSME propellant valve problem history from 1992 through 1997; (2) providing SSME plumbing system problems from the first 5 years and the most recent 10 years of the program for use by the Transportation Directorate; (3) extracted and provided 54 MSFC and KSC PRACA problems regarding SRB loose backshells and cabling; (4) and finding all MSFC flight debris problems in MSFC PRACA. The PAC also supported the S&MA Office by designing and implementing a display on S&MA activities and programs for presentation at the MSFC NASA new employees' orientation.

(PWS 6.3.3) In implementation and operation of the MSFC CAS, the PAC received 40 potential CAS reports, screened 39 draft Recurrence Control Action Requests (RCARs), and initiated 2 new RCARs. The PAC received 5 responses from laboratory points of contact with either disposition rationale or

response extension requests. The PAC coordinated Corrective Action Board review of 2 RCARs (resulting in full closure of both of them). The PAC also provided open RCAR status reports and discussed them at the Marshall Management System (MMS) Implementation Team meeting, issued monthly RCAR status and delinquent response reports, presented monthly metric charts of RCAR activities and statuses at the MMS Implementation Team. The PAC briefed the QS internal auditors on operation of the Corrective and Preventive Action Systems, assisted in developing responses to four internal audit findings; and were surveyed by the NQA auditors, with no discrepancies no being charged. The PAC also submitted changes to the QS-R-012, "S&MA Operation of the CAS."

RA continued to support the OSP RMS Working Group by coordinating and organizing teleconferences, issues, comments, documentation, actions, etc. Major current activities of the WG include development of the OSP RMS Engineering Plan and the OSP PRA Plan.

4.2.3 ALERT Program

HEI's ALERT support included both regular and special activities as HEI coordinated MSFC ALERT processing. HEI received and distributed 19 ALERT announcements for MSFC review and obtained 2,727 responses from MSFC project, contractor, and laboratory contacts. HEI ALERT: (1) reviewed and approved 11 new MSFC ALERT database accounts via the TPS security. HEI generated monthly Open, Delinquent ALERT response tabulations and provided them to S&MA and/or Directorate single points-of-contact responsible for open ALERT reduction; (2) participated as secretary to the GIDEP Industry Advisory Group (IAG) monthly teleconference; (3) presented MSFC's closed-loop ALERT processing technique to the other NASA Centers at a NASA Headquarters ALERT meeting; (4) assisted processing of delinquent ALERTs by the MSFC projects and directorates – that resulted in only 603 delinquent when we presented the count at the Marshall Quality Council meeting; (5) met with NGLT/OSP representatives to clarify their ALERT processing organizations; (6) led a meeting among S&MA and the Science Directorate to draft requirement changes for NASA ALERT processing; and (7) drafted and clarified software changes to pro-actively notification MSFC ALERT actionees of approaching ALERT due dates and to grant 30-day extensions, when justified. HEI also reviewed three separate draft ALERTs for MSFC and MSFC contractors.

4.3 Quality

Space Transportation

External Tank (ET) Quality Engineering (QE) supported the ET Contingency Team, providing quality input and recommendations for test article preparation and testing associated with the STS-107 failure investigation. QE witnessed foaming operations of test articles, met with MSFC Test Facility quality personnel and prepared documentation for the level of quality control/involvement in test activities to be conducted at MSFC, and attended Test Readiness Reviews (TRRs) and witnessed article testing. QE is also continuing to provide action responses related to the STS-107 investigation. In addition, QE participated in ET quality escape teleconferences to evaluate Lockheed Martin nonconformance documents and KSC problem reports for the months of April and May and prepared quality escape reports documenting the findings.

Solid Rocket Booster (SRB) QE provided support to weekly Booster Separation Motors (BSM) Integrated Process Team meetings, providing input to the hardware Production Schedule, Qualification Schedule, and Status of open Vendor Problem Reports. QE provided quality expertise to the failure investigation of the ATJ Graphite material is used in the BSM Nozzle Throats. QE supported and provided quality review and input to MSFC/USA SRB Element Weekly Engineering and SRB Chief Engineer's Problem Report meetings. QE evaluated SRB Pyrotechnic hardware Vendor Problem Reports and SRB Elements Engineering Change Evaluations. QE supported the USA-UPCO Weekly Pyrotechnic Working Group meetings and provided quality input to UPCO's manufacturing processes. QE participated in a Quality

Product/Process Audit on the Nose Cap Thruster; Lot AAN at Good (UPCO) Fairfield Ca. QE supported weekly BSM Igniter Open Air Tests erratic test failure investigation meetings.

Space Shuttle Main Engine (SSME) QE provided S&MA management with descriptions of Space Shuttle Main Engine Program processes to help complete an overview of Shuttle S&MA. QE also provided support in proofing the S&MA management charts presented to the CAIB members on 4/1/2003.

QE drafted the CSPA for the work to be performed on the STS-107 released leading edge RCC material. The handling requirements set in the CSPA states the hardware will be treated as "Quality Sensitive", meaning the hardware will be logged in and out of each location and activity so as to ensure the hardware can be easily tracked and located at any time as well as provide a history of all work performed on it.

QE drafted the Customer Supplied Product Agreement (CSPA) for the work to be performed on the STS-107 released BSTRA assemblies. The handling requirements set in the CSPA states the hardware will be treated as "Quality Sensitive", meaning the hardware will be logged in and out of each location and activity so as to ensure the hardware can be easily tracked and located at any time as well as provide a history of all work performed on it. Quality will review the tracking and logging system and provide guidance. QE has also inserted specific quality requirements into the work outline to ensure S&MA participation during critical operations and packaging of the hardware

QE coordinated with quality assurance, security, shipping/receiving, and qualified program critical hardware certified operators to move the 400 lb box of seven BSTRA assemblies from a locked room in bldg. 4471 to a quality controlled area in Bldg. 4705. A receiving inspection was conducted consisting of a count and condition inspection as well as digital pictures of each part before and after they were removed from the packing materials. The hardware was scorched, dirty, and pretty banged up. However, the BSTRA balls inside the assemblies appear to be intact. An M&P photographer and a plasma torch expert viewed the hardware on Monday, April 14, 2003, took pictures, and discussed strategy of how best to retrieve the balls from the BSTRA assemblies. From there, traveler procedures were written for each assembly outlining the work to be performed in retrieving each ball and the NDE testing performed. Quality witnessed the retrieval of each ball, participated in the re-packaging of the remaining pieces, and took a digital picture record of the event. All remaining pieces of the BSTRA assembly are to be placed back in the original box after removal of the balls for controlled storage.

QE participated in the development of the Gimbal Test Article (GTA) and worked with the designers to ensure safe incorporation of the test article into the SSME test program. The GTA is being developed to show positive structural margins to the existing flight flow-liners due to the discovery of an additional loading environment from backflow of the space shuttle main engine low-pressure fuel pump. The GTA is instrumented to quantify this new environment and its structural effects on the flow liner.

QE participated as an auditor on the 2003 Configuration Management Audit of the Rocketdyne, Canoga Park Facility. Four days of auditing were conducted with audit team members comprised of NASA Configuration Management, SSME S&MA, and SSME project engineering. A total of thirteen findings and forty-one observations were recorded in both phases of the audit. QE provided two observations against the Configuration Management Requirements. Rocketdyne will develop answers and corrective actions to all findings and observations given by the assigned due dates for each instance.

Reusable Solid Rocket Motor (RSRM) QE reviewed engineering change proposals, process change proposals, and Material Review Board items for quality and certification impact. QE also attended and reviewed information presented at RSRM milestone reviews, and weekly RSRM propellant, liner, and

corrective action reviews. RSRM QE has acted as the S&MA main point of contact for the RSRM Propellant Structural Analysis issues and pending waiver.

Quality Assurance (QA) participated in process audits of 2 vendors for QS40 and continued support of workmanship and training requirements development of the J-STD-001C and NASA Addendum contract, with ACI Technologies. QE participated in several meeting with Joint Group on Pollution Prevention's (JG-PP) Lead Free Solder Project and participated in QS20 Shuttle Assurance Team reviews.

Software Quality Assurance (SQA)

Software Assurance (SA) provided expertise to the ED14 Software Process Improvement (SPI) Level 3 Software Capability Evaluation (SCE) of the Capability Maturity Model (CMM). SA personnel were interviewed and provided documentation and supporting materials to assist in obtaining Level 3 certification. Activities related to this assessment also included revising SA Organizational Instructions (OI), establishing a centralized repository for SA materials, and tailoring the system used by ED14 for problem reports to track SA audit findings and observations. MSFC ED14 is the first NASA organization to successfully achieve a CMM Level 3 assessment by the Software Engineering Institute (SEI) at the Carnegie Mellon University. Software Assurance (SA) also performed an ED14 Flight Software Group Organizational Software Implementation Audit. The ED14 Software Development Process Description Document OWI, ED14-SS-001, and was reviewed and interviews were conducted with ED14 personnel. Two findings were noted and observations included no clear definition in the OWI of how logged results are maintained by developers for unit testing.

Software Assurance (SA) supported the Material Research Science Rack (MSRR) Materials Science Laboratory (MSL) projects with an acceptance data package (ADP) review. SA reviewed ADP documentation submitted by the European Space Agency (ESA) for the MSRR MSL Engineering Model (EM).

Software Assurance (SA) supported the Glast Burst Monitor (GBM) project providing QA expertise during a review documentation for the GBM Ground System Preliminary Design Review (PDR) conducted at the National Space Science and Technology Center (NSSTC) May 1, 2003. The PDR was a technical review of GBM ground systems hardware and software, developed by MSFC and University of Alabama in Huntsville (UAH). GBM Ground Systems will be used for pre-launch integration and testing, and for post-launch operations and data analysis. All concerns and issues were discussed with GBM team members and resulted in submittal of a Request for Action (RFA) form. The RFA subject addressed that no provisions are made to include SA in Verification and Validation activities for Software testing performed by the GBM Ground Software Test Team.

Software Assurance (SA) supported the SOLAR-B providing input to assess the status of the Extreme Ultraviolet (EUV) Imaging Spectrometer (EIS) software testing performed during the period 4/22/03 – 4/25/03 at Assurance Technology Corporation (ATC) in Chelmsford, Massachusetts. Several concerns were identified, including inadequate test verifications, high number of problem reports, and lack of unit testing. Corrective steps were also identified to mitigate potential damage of the EIS mechanisms hardware during Flight Hardware testing with Flight Software.

ISO

ISO QE has continued to play a key role in ensuring the maintenance of ISO 9001 at MSFC during this time period. Efforts have dealt with continuing implementation of the ISO 9001:2000 revision, maintenance of documentation, and planning and support for the NQA registrar audit, including preparation of self-assessment checklists for the MSFC organizations, escorting during the audit, and follow-up and closure of corrective actions. QE provided general ISO support, including reviews of MSFC and NASA Agency documentation, training, Marshall Quality Council (MQC) meeting

preparation, and consulting support on internal audits, records, planning for process changes, the deviation/waiver process, and other aspects of ISO 9001, to various MSFC Organizations. QE also participated in a NASA Agency Quarterly Quality System Status Review meeting at NASA Langley.

QE has played a key role in preparing for the MSFC audit to AS9100. Efforts have dealt with coordination with owners of documentation, review and revision of MSFC directives, and preparation of a matrix of MSFC documentation to the AS9100 requirements for review by NQA prior to the registration audit on June 17-18. This audit was conducted in conjunction with the ISO 9001 surveillance audit. MPD 1280.1, "Marshall Management Manual," was revised by QE to address the AS9100 standard.

Payloads

QE performed Drawing Reviews, Procedure Reviews, Test Readiness Review, and Procurement Reviews, Inspection Requirements, Shipping Requirements, and/or supported team meetings for MPLM, BiC, BRP, TES, OPCGA, Delta-L, ECLSS, QMI, SHIVA, GBM, MSRR, GP-B, Solar-B, MSG and GEDS.

QE reviewed project plans for BiC, MSG, EGN, OPCGA, and Delta-L and updated the SSP 50431 compliance matrix for each. QE reviewed and provided comments for verification closures for OPCGA and TES. QE reviewed and provided comments to SHIVA Project Plan. QE provided quality expertise to Material Review Boards for ECLSS, MSRR, and g-LIMIT. QE reviewed Acceptance Data Package (ADP) for GP-B, Solar-B, and MSRR. QE generated an S&MA plan for MSG.

QE conducted an assessment of the Coupled Growth in Hypermonotectics and Particle Engulfment and Pushing by Solidifying Interfaces (CGH/PEP) Sample Ampoule Cartridge Assembly (SACA) project documents for Systems Requirement Reviews (SRR).

QE served as a member of the Red Team for the XPE Proposal. The Red Team reviewed the proposal, discussed and consolidated findings, and made recommendations to the proposal team. The revised proposal will be presented to headquarters.

QE developed a chart to show how the requirement for quality flows down from the Headquarters level to the project payload level.

Inspection and Test

QE reviewed and provided comments for the moving and handling procedure for the Northrop Grumman composite tank. QE reviewed and released procedures for the test facility build up and the testing of the Northrop Grumman composite tank, the Laser Ignition system, the Goddard Flight Replica, and the Shuttle investigation testing.

Quality Assurance (QA) continued to provide support in all MSFC test areas to MSFC S&MA by monitoring quality assurance operations to/with MSFC test engineers and contract support personnel. The Metco Combined Environment Facility, the Improved Hot Gas Facility, test stand 115 and test cells 101 through 109 are among the test areas supported by HEI QA. A Test Readiness Review (TRR) was presented on the Colombia investigation (test no. 6). Test procedures and planning were reviewed to ensure that proper quality and test requirements were met on a day-to-day basis. Quality Assurance continued to perform video scope inspections and witnessing of assembly and testing for the Columbia Investigation (test # 6), Cycle Life Testing on a Vacuum Plasma Spray (VPS) GRCOP-84 Chamber Liner for NGLT, the Vortex Thrust Chamber, an 11 inch Instrumentation Development Motor and an 11 inch Gas Path Fundamental Motor (both RSRM) and the Replica Goddard Motor.

4.4 Information Management (IM)

Information Management completed numerous IT improvements and made significant progress toward completion of major development projects over the quarter. The first phase of development for the Safetrak application was completed. Activities completed in support of Safetrak this quarter involved a large degree of cooperation between the Facilities department and the S&MA organization in order to modify both electronic and supporting manual processes to implement improvements. A demonstration of the application will be held on 07/09/03, and a beta test will follow through 07/18/03. The application is scheduled for deployment in 09/03. The audit shell and the observations modules of the Internal Quality Audits (IQA) application were completed except for notes and interface with the Nonconformance Reporting (NCR) application. The first phase of IQA is scheduled for beta test beginning in 09/03. Modifications to the replacement Space Flight Awareness (SFA) application were incorporated in order to check the Center's personnel database and an SFA table as necessary to uniquely identify individuals. This functionality will allow for all records associated with an individual to be retrieved in a search regardless of name or employment changes. It will also simplify data input by decreasing the field data that needs to be entered manually. The replacement application will be released for beta test in 07/03. The Virtual S&MA web site, which will standardize S&MA's web pages, was revised to incorporate comments by the Organizational Chief Information Officer (OCIO). The site is currently being beta tested.

Numerous existing applications were modified to incorporate improvements. The Inventory of Hazardous Operations (IHOPs), SafetySearch, and the Safety Concerns Reporting Systems (SCRS) were modified to interface with a new application called Building. Building will contain updated MSFC building and associated responsible personnel. All S&MA applications using this information will pull the data from Building, so that changes only need to be made in one location. The process modifications are scheduled for incorporation in 07/03. Additional completed modifications to improve the update and delete functionality in IHOPs and to interface SCRS with S&MA's integrated login application will be deployed at that time. The Peer Awards and the QS Employee Satisfaction Survey applications were also modified and deployed. Numerous modifications to these and other applications, including Audited Vendor List (AVL)/Limited Vendor List (LVL), Checklist, Supervisor Safety Web Page (SSWP), Haztrak, Information Management Support Request (IMSR), ALERTs and the Building Manager page were also implemented.

Other significant activities include support to the S&MA Requirement Tool (SMART), coordination of needed document management capabilities, server activities, and response to a data call. In support of SMART, all of the identified documents have been run through the Automated Requirement Measurement (ARM) tool, and data from approximately 50% of them has been extracted from the documents and input into the SMART database. In addition, procurement requests for necessary software products were issued. Plans for document management and search capabilities supporting the S&MA Shuttle Assurance Department were coordinated. Server upgrades were performed in order to install hardware, upgrade development products, and incorporate patches. Significant support was required to configure a report builder product and produce instructions for its use. IM also produced documentation in support of the FY03 IT Pop Call.

4.5 Human Exploration and Development of Space (HEDS) Assurance

During this reporting period, the MSFC HEDS Independent Assessment (IA) group continued to support a wide range of S&MA activities. HEDS IA began the development of a Certificate of Qualification Policy at the request of QS40 management. The initial draft of this document has been completed, submitted for review and distributed for comment.

IA participated in a Team Assessment of the OSP DART and PAD programs to assess potential schedule and or cost impacts due to S&MA issues. IA also participated in a presentation of the assessment results to the Headquarters customer, Code R.

Revisions to the Organizational Issuance (OI), Independent Assessment Implementation Plan, providing operational instructions for the Independent Assurance group were formalized and submitted to IA Manager for review.

IA has completed the preparation of the Advanced Quality Training Course and has received the ISO-9000 presentation that will be used in preparation of the next level Quality Training Course-104.

The research for writing an initial draft of the S&MA contingency response Organizational Issuance (OI) is underway.

4.5.1 International Space Station (ISS) Independent Assurance

The IA out briefing of the Payload Operations Integration Center (POIC) assessment was conducted on 04/15/03. The POIC management accepted the report with its observations. There were two recommendations in the report: 1) make the procedure for calling the POIC safety position more specific and 2) continue to hold meetings with the Mission Control Center (MCC) and Mission Evaluation Room (MER) to insure good communications on POIC/MCC/MER safety concerns. The Code Q customer has been contacted and results have been forwarded.

The final report of Assessment # MH-2001, Flow Down of SSP 50431 into MSFC Payloads, was discussed/reviewed with MSFC S&MA Management and outbriefed to the MSFC S&MA Cargo Manager. Outbriefing to the Microgravity Science and Applications Department management has been scheduled and rescheduled due to availability issues with all needed participants

IA of ISS/S&MA (JSC, KSC, and MSFC) Stage Operational Readiness Review (SORR) & Flight Readiness Review (FRR) CoFR Review Process (JKM-3002) is an ongoing collaborative assessment with JSC and KSC IA to determine the health of the ISS CoFR process. Team activities that have been accomplished are: 1) the Assessment Plan has been reviewed and approval signatures have been obtained; 2) checklist questions and management interview questions have been developed, reviewed, and approved; 3) team personnel has been finalized; 4) personnel to be interviewed is being established; and 5) MSFC in-briefings have been held with the MSFC S&MA Director and S&MA Cargo Assurance Manager and his lead personnel. The assessment began at JSC during the week of 06/23/03, and will move to MSFC the week of 07/07/03, and KSC the week of 07/14/03.

IA conducted a follow up of the Independent Assessment MH-2004 for Boeing Huntsville, ISS records for support of sustaining engineering. IA Analysts met with DCMA at Boeing Huntsville ISS to review the observations and recommendations that will be evaluated during the follow-up phase of this Assessment.

4.5.2 Space Shuttle Independent Assurance

Presentation material was provided to QS40 for use during the visit of the Columbia Accident Investigation Board (CAIB). IA participated in meetings between the CAIB and S&MA personnel. A presentation by IA Manager regarding the activities of the IA group was given. Also, presentations by MSFC S&MA, DCMA, and Space Shuttle Prime Contractor personnel were given describing S&MA metrics used to manage the MSFC propulsion elements. IA provided S&MA management a summation of all questions asked by the CAIB members.

IA completed an assessment (# JKM-3002) which evaluated the methodology, approach, and processes that SR&QA uses to satisfy the Certification of Flight Readiness (CoFR) of the Space Shuttle Program this period with an out brief to the requesting organization, Code Q, and the customer, Code M. Following completion of the Shuttle portion, work on the ISS CoFR assessment was intensified. The Centers collaborated on an in-briefing presentation and the checklists to be used for personnel interviews. Team assignments were finalized and plans are progressing for this portion of the requested assessment.

IA participated in S&MA Space Shuttle Return to Flight planning sessions and agency wide teleconferences.

During support of the technical teleconferences and meetings concerning the SSME activities, on Return to Flight and the daily activities of motor buildup and testing, it was discovered that a fuel high-pressure turbopump that had been at KSC and was to be shipped back to Rocketdyne for checkout and repair had been compromised during transit. It was originally thought that the engine was shipped via air but this is being investigated. The shipping seals were disturbed and tie wires on the hardware were broken. An investigation is underway to determine why there were shipping problems and appropriate measures will be taken to avoid this in the future.

IA participated as a Team member of the ETM-3 Independent Assessment Team (IAT) which convened on 05/14/03 - 05/15/03 at the ATK facility at Promontory, Utah to review the Engineering Test Motor (ETM-3). The Final Report for the team has been released. In addition to the 53 actions from the meeting, of which 18 were "test constraining", there were 6 significant recommendations and 5 observations. Thiokol continues to address these and the meeting actions. Those that are test constraining must be closed prior to the Test Readiness Review (TRR) planned for August. The conclusion from the Team review is that ETM-3 is ready to test pending satisfactory closure of the test constraining actions. A separate IA assessment report from the HEI IA group will follow.

The ongoing MSFC Independent Assessment Activity # MH-3003 is in the process of determining the adequacy of the ET Bipod Re-design Down-select/Preliminary Design Review effort that was initiated during the week of 4/18/03. Logistics preparation for the team, and efforts to obtain and provide data for team review has been completed. The pre-PDR review has also been completed and the results have been provided to QS40 management along with all published data required to determine the final IA position on the chosen re-design selection.

4.5.3 Space Launch Initiative Independent Assurance

The MSFC IA Manager and IA Supervisor held an introductory IA briefing with the OSP Program Manager, Dennis Smith and the Program Mission Success Manager, to present the role and capabilities of the IA team.

IA personnel met with the New Generation Launch Technology and Orbital Space Plane offices and are participating in many of their meetings. These programs have various propulsion activities in the design stage. IA is monitoring these activities.

HEI IA is in the process of obtaining access to the databases of the various projects of the Orbital Space Plane (OSP) and Next Generation Launch Technology (NGLT) programs. This follows the presentations to the OSP Program Managers by MSFC S&MA to explain the roles and responsibilities of IA and how we might assist in the design and development of prototype and flight hardware. This effort requires multi-forms from each IA individual and approval by each project manager. Access to this data will give IA much greater insight to the design concepts.

4.6 Project Assurance

Project Assurance Engineering (PAE) supported S&MA in preparation and during actual briefing to the members of the CAIB 04/01/03 - 04/02/03. In preparation PAE analyzed Defense Contract Management Agency (DCMA) and Government Mandatory Inspection Point (GMIP) data and prepared briefing charts. PAE coordinated dry run of the presentations and made real time changes to the material in support of the S&MA Office and various contractors.

PAE prepared forecast for Shuttle Assurance Civil Servant workforce as well as Contractor support for FY04 POP. PAE developed spreadsheets to display current workforce levels and current vacancies. PAE prepared databases for FY04 Travel requirements, FY04 Other Direct Cost requirements and FY04 through FY09 Defense Contractor Management Agency (DCMA) forecast. PAE coordinated inputs from the Department as well as the Assurance teams. PA presented these worksheets to the Department and after approval PAE submitted the forecast to QS01.

RSRM PAE evaluated an engineering change proposal to the FSM-11 static test motor. The proposal was the addition of 88 instrumentation gages in the insulation of FSM-11. Data from these gages will continue to anchor points for thermal and structural modeling of internal insulation performance. There are no impacts to the baseline risk and/or risk documentation.

RSRM PAE evaluated a manufacturing change to the baseline RSRM process. Thiokol proposed to replaced ozone depleting chemical (ODC) solvent cleaning of natural bristle brushes with 100% Fourier Transfer Infrared Spectrophotometer (FTIR) inspection of critical process application brushes. The FTIR inspection assures that the brushes will be free of contamination that may impact the performance of the RSRM. This change supports the ODC elimination effort. RSRM Shuttle Assurance assessed this change as "no impact to risk".

SSME PAE has served as the recorder for the SSME Working Group investigation into the loss of STS-107. The PA representative accompanied a small sub-set of the SSME Working group to JSC for presentation of the fault tree closure rationale. The Multi-Element Integration Closure Team, the Orbiter Vehicle Engineering Working Group, and the NASA Accident Investigation Team accepted the block closures. In addition the CAIB, led by Admiral Gehman, concurred with closure of the SSME fault tree, with administrative comments. Preparation of the final report is in work.

PAE Engineering is representing S&MA on the team investigating the Boeing Swirl Injector test failure that occurred at Stennis Space Center on April 10, 2003. The objective of the test, the first in a series of bipropellant tests, was primarily an examination of ignition characteristics of a bipropellant system. The failure began when high concentration hydrogen peroxide (>95%) detonated in the H2O2 dome, ejecting the high-pressure transducer, thermocouple, and ablative nozzle.

RSRM PAE prepared and performed a training session on the RSRM Hazard Reports for the RSRM Project Office. The RSRM Chief Engineer requested this training to aid the project in the "return to flight" process and to demonstrate to the project the importance of the S&MA review of change proposals. The training emphasized the Level II requirements, RSRM Hazard Report contents, and the "4x3" Risk Matrix.

PAE assisted in the support of the STS-107 SRB Working Group investigation. PAE assisted with QS20 and United Space Alliance (USA) in the preparation of the Working Group fault tree closure presentation and compilation of data for the team's report. As the assigned S&MA representative on the SRB Bolt Catcher Working Group, PAE supported the development and planning of the SRB forward bolt catcher assembly test program by witnessing an inspection conducted by ED23 and QS30 on two bolt catcher assemblies supplied by USA.

PAE supported the CAIB Management and Depth of Penetration for risk assessment associated with the Space Shuttle Program (SSP), with a focus on the Columbia Accident. Several Documents from previous SSP Accidents/Incidents were reviewed to assist in evaluations of the findings and recommendations in the areas of S&MA Management and Depth of Penetration into RISK Issues, Investigation, and Management Acceptance of Risk. Also, several of the previously held CAIB Public Hearing Transcripts were reviewed to ascertain the level of depth and understanding of the CAIB Member's Questions and areas of interest. A list of Management and Depth of Penetration Questions and sources for answers were provided electronically on 4/17/03. Participation in an electronic meeting allowed interaction among the participants who also provided insight into potential answers to all questions submitted. No further follow-up activity is identified at this time

PAE participated in the TRR for the T/V test of the Space Vehicle (SV) held at Lockheed Martin (LM) in Palo Alto, CA. There were 19 action items resulting from this TRR, all of which will be closed prior to the start of the test.

PAE participated in the PAD Abort Demonstration (PAD) System Requirement Review conducted at the Lockheed Martin location in Denver, Colorado. Except for a few action items, the SRR resulted in acceptable level of documentation that is sufficient to proceed to the next level - preparation for Preliminary Design Review.

The non toxic APS system level net meeting/technical interchange was conducted on 05/07-05/08 at MSFC to resolve issues related to the White Sands Test Facility (WSTF) Test Bed in real time, prior to the actual CDR on 05/29/03. Documents under review included the Systems Requirements Document (SRD), all ICDs, engine controller requirements, facility requirements, the FMEA and Hazard Analysis. PAE came forward with issues related to feed line system proof test requirements, drawing revisions annotating initial & subsequent leak check requirements, the net reduction in hazards resulting from eliminating toxic propellants (hydrazine) in favor of lox/ethanol thrusters, lifting/handling equipment load test requirements, test article fixture issues, FMEA concerns, and test plans.

PAE continues to assist QS20 in support of the STS-107 SRB Working Group investigation. PAE participated in the co-chairman's dry run presentation to representatives of various MSFC organizations and the SRB Working Group Senior advisors. Constructive recommendations were made to improve the presentation material.

PAE reviewed the Flight Lot Certification for Lot ABP SRB Range Safety System Linear Shaped Charge (RSSLSC) submitted by United Space Alliance (USA). The lot certification documents the acceptance of 8 Forward Initiation RSSLSC Assemblies, 12 Aft RSSLSC Assemblies and 42 Intermediate RSSLSC Assemblies.

Project Assurance (PA) worked with Shuttle Projects Upgrades manager and Shuttle Assurance Department in preparing SLEP FY04 through FY09 workforce forecast. PA met with each MSFC element upgrades / business office representative to assure that the S&MA Civil Servant workforce was covered in the SLEP forecast.

In response to CAIB request for Shuttle Assurance, PA researched and gathered presentations material focusing on foam loss on flights that had foam loss from the ET, and how the subsequent flight's review dispositioned that specific issue. PA queried the Prelaunch Assessment Review Database and located the files, and reviewed the presentations to assure that the information was pertinent to the CAIB's request.

An informal assessment of the current Hazard Reports (SRB, ET, Orbiter and Integration) that address debris hazards was provided to QS20. As a follow up activity, a time line of the MSFC SSP Element presentations on debris issues to the Shuttle Safety Review Panel is being prepared.

Assessment of SSP In-Flight Anomalies (IFA's) is being performed to determine if the serious Risk Issue of lost foam debris from the ET was either being "lost in the shuffle of other technical issues" or being "underestimated" by the handling of these reported events by the Program/Projects. This effort will also try to uncover any unique circumstances between these debris events and the OV-102 Orbiter. Several data sources and databases are being searched and utilized in support of this activity.

PAE participated in the Quarterly Safety TIM on 05/09/03 and the GP-B Ground Operations Working Group (GOWG) meeting on 05/10/03. There were no significant S&MA action items resulting from the GOWG meeting. The Lockheed Martin System Safety Engineer agreed to update the Missile System Prelaunch Safety Package.

In support of the development of System Safety skills within the S&MA organization, a presentation is being developed to address the keys to effective project system safety support. The initial material will focus on the Space Shuttle program. Later presentations will be tailored to other programs/projects that MSFC S&MA supports.

RSRM PAE evaluated a discrepant condition on the RSRM Igniter Chamber. Due to repair of metal pitting, the port diameter in the OPT special bolt o-ring area was oversized. This condition raised the safety concern of the sealing integrity of the igniter chamber. Leakage past this seal was mitigated by analysis that concluded the o-ring squeeze will meet minimum requirements. Structural concerns have been mitigated by successful proof-test.

RSRM PAE evaluated a post-test anomaly observation on the RSRM Flight Support Motor (FSM-10). Post-test inspection observed light corrosion on the forward segment field joint tang. The corrosion was determined to be due to the excessive time specification for leaving metal surfaces un-protected during post-test assessment and disassembly.

In support of the MSFC Shuttle Systems Working Group (SWG), review of the RSRM, SSME, and SRB STS-107 Accident Investigation Fault Tree Blocks was completed and summary Matrices were provided as inputs to the SWG Preliminary Report. This review consisted of assuring that the SWG Fault Tree Blocks were being properly addressed both in the Element Fault Trees and the STS-107 Integration/CAI Fault Trees. One omission was found where the debris from the SRB Hold-down posts was not being included in the JSC Integration Matrix for Liftoff debris.

In support of Columbia Investigation, provided a comparison of the missions where ET and Orbiter IFAs and the missions where Bipod foam loss was noted. The comparison showed that 3 missions (STS-7, STS-50, STS 107) were declared as IFAs while 4 missions (STS-32, STS-52, STS-62, and STS- 112) were treated as "in-family".

As part of a continuing dialogue on S&MA activities for the Shuttle return-to-flight effort, several suggestions were made to both HEI and MSFC S&MA management on improved processes for S&MA participation at the different levels that make up the SSP flight readiness effort. Areas addressed included the scope of PAR presentations and the selection of safety issues to be presented to the SSRP.

In response to a QS01 action for the Center, PA assisted Shuttle Assurance Manager in forecasting workforce competency needs for QS20. PA developed a workforce database that cross cuts needs by workforce, element and competency.

After reviewing an LM variance request developed in order to comply with East/West Range (E/WR) safety requirements, PAE provided detailed direction as to how to write the variance so as to meet E/WR variance document requirements. This variance addresses ground support equipment (GSE) (Gas Delivery System, Vent Service Cart, associated manifolds) required to service the Guard Tank while the Spacecraft is on the launch pad. The revised variance request will be forwarded to E/WR Safety after it is approved by QS30.

PAE participated in the May Monthly Program Review held at Stanford University for GP-B during this reporting period. There were no action items directed to QS30 during this review.

New completion dates were provided for two MSFC Directives, which were in the process of being updated at the time of the Columbia accident. MWI 1700.1C (Payload Safety Readiness Review Board) is now scheduled for July 1, 2003, and MWI 1700.2A (System Safety Program) is scheduled for August 1, 2003.

PAE was assigned an action to revise the S&MA section (WBS 2500) of the ISTAR Statement of Work (SOW) to reflect changes being implemented for the current stop-gap period. The additions included a requirement to perform facility hazard analyses prior to any rig tests and to update the applicable analyses as required when changes in procedures and/or hardware are incorporated.

RSRM PAE prepared a RSRM S&MA Overview presentation for the QS20 Department. The material covered the government's activities in S&MA including surveillance, audits, metrics, mandatory inspections, non-conformances, corrective actions, hardware acceptance, and postflight assessments. The audience included all shuttle elements in QS20 including the Resident Management Offices. The presentation was well received and the shared information will be utilized for process improvement in developing "best practices" in the Shuttle S&MA community.

In support of QS20 and the MSFC Shuttle Systems Working Group (SWG), the External Tank (ET) Fault Tree Mapping to the SWG, Integration, and Columbia Accident Investigation (CAI) Fault Trees was completed in EXCEL format, in matrix form, for inclusion in the SWG Final Report. This review consisted of assuring that the SWG Fault Tree Blocks were being properly addressed both in the Element Fault Trees and the STS-107 Investigation Fault Trees. This delivery of the ET Matrix, on 06/01/03, completes the S&MA SWG Action to perform this assessment for all MSFC Elements.

In Support of QS20, a detailed assessment of the occurrence and potential impact to the Orbiter Wing Leading Edge RCC due to the Pin Hole phenomena was completed and provided to appropriate organizations for review/ assessment. Issues which are being raised include: Why were the occurrences of Pin Holes not considered In- Flight Anomalies; Has the root cause and growth potential for these Pin Holes been fully understood; Why was this potential issue not briefed to the Safety organizations, including the Systems Safety Review Panel; Why was Limited Life of these RCC items not considered a Hazard Control; Since the original designed and certified Limited Life of these RCC items was reduced by almost half, why wasn't this considered an increase in risk; and Would RCC Areas on the Orbiter, containing Pin Holes, be more susceptible to impact from Debris? This assessment was performed using available data and further analysis on additional data could shed more light on these Issues.

PAE, as the S&MA participant in OSP Program Integration team for the preparation of the OSP Minimal Functional Requirements study using Axiomatic Design, finalized the study and presented its contents to the OSP Program Manager and other individuals. The OSP Program Manager was very pleased with the study and it seems to have answered his concerns as to the level of functional decomposing required at this stage of the program.

PAE represented QS20 at the 10 Second Delay Cutter Phase III Review held 06/10/03 – 06/12/03 at Pacific Scientific Energetic Materials Company, Chandler, AZ. The phase review team included representatives from MP41, United Space Alliance (USA) Engineering, and USA QE. The team conducted hardware inspection, examined radiographic film, and reviewed manufacturing, test and inspection documentation for Lot ACF Delay Cutters. The flight Lot Certification for 103 units was submitted for QS20 review and approved.

PAE continues to support QS20 in the BSM Open Igniter Test Anomaly Resolution Team activities. The team was chartered to investigate erratic pressures observed during open-air igniter qualification testing of new sources for Boron Potassium Nitrate (BKNO3) and Ammonium Perchlorate (AP) at United Space Alliance (USA) subcontractor, Pratt & Whitney Space Propulsion. The team has been working to develop a test plan to determine what factors may lead to cause of the erratic pressure and best evaluate the effect of erratic igniter pressure on BSM performance.

ET PAE evaluated and engaged in the ET Bipod Redesign PDR at the Michoud Assembly Facility (MAF). Redesign of the ET bipod has been identified as a constraint for return to flight. The proposed redesign centers around the removal of the foam ramp over the bipod, which protected the fitting from ice/frost formation during pre-launch tanking and aero thermal heating during flight. Ice/frost formation will be mitigated with the addition of heaters under each bipod fitting. Aero thermal protection will be mitigated with material changes and analyses. ET PAE evaluated the PDR package and submitted several Review Comment/Action (RCA) relative to risk concerns with the redesign.

4.7 Risk Management and Risk Assessment

4.7.1 Risk Management

HEI Risk Management PAE taught a four-hour course on Continuous Risk Management (CRM) as part of the Program Planning and Control series of courses. The series is designed to enhance the Center's skills in the program planning and control area. Eighteen students attended the CRM module.

HEI CRM PAE tailored a risk management overview and risk management identification workshop for the Dynamical Selection of Interface Patterns (DSIP) project. PAE reviewed the DSIP project documents and developed a Continuous Risk Management workshop to assist the project in their risk management identification activities. The workshop with project personnel was facilitated by PAE on 05/14/03 resulting in the project identifying and analyzing risks that can now be dealt with in the framework of the project risk management system. PAE also provided information on ePORT risk management database that will be used to track and control the project risks.

A CRM training course was presented by PAE on 06/12/03 – 06/13/03 to S&MA QS40 staff and OSP program personnel. In attendance were three MSFC S&MA personnel, one Stennis Space Center contractor safety engineer and two persons from the OSP Program. From 06/24/03 – 06/26/03, PAE helped coordinate a CRM Train-the-Trainer class. The instructors from GSFC came to MSFC and taught a three day course to personnel who are now prepared to become certified CRM trainers. There were three students from MSFC, one from SSC, one from JSC and two from DFRC.

4.7.2 Space Shuttle Probabilistic Risk Assessment (PRA)

During this reporting period, Risk Assessment (RA) participated in a Shuttle Probabilistic Risk Assessment (PRA) technical interchange meeting at JSC to discuss current Shuttle PRA results and methodology with other Shuttle PRA team members in preparation for the upcoming Independent Peer Review (IPR). RA has prepared and forwarded to JSC two revisions of the MSFC SAPHIRE PRA models

in April and June. The results from the April revision were presented to the Shuttle PRCB. The results from June submission contain the final models to be presented to the IPR.

RA is directly supporting the ET, SRB and SSME PRA efforts, and has assisted in adjustment of the models in response to internal project review comments and comments from the PRA technical lead. All of the propulsion modeling is complete. RA has reviewed the ET and SSME models and has started reviewing SRB and RSRM. Also in this reporting period, RA is directly involved in compiling the required documentation for each of the MSFC Propulsion Elements for both MSFC and JSC, including the IPR.

4.7.3 Reliability Prediction & Risk Analysis

Risk Assessment (RA) continued to support the ET Working Group for the Columbia investigation. RA traveled to MAF to attend technical reviews of major tests and kept S&MA ET team members apprised of test progress and milestones. RA communicated issues with Safety personnel to assure they could be aware of their test customers' needs. RA represented ET S&MA at a pre-test meeting for ET Working Group Wind Tunnel testing at Arnold Engineering Development Center (AEDC). Items for preparation of the Test Readiness Review for calibration runs were discussed.

RA revised an analysis of bipod loss and production data requested by the ET Working Group TPS Subteam and the ET Return to Flight Working Group. It was found that Columbia had the lion's share of bipod foam loss events (5 of 7 events); in fact, that number was more than could be accounted for by chance alone. It was also found that rainfall during the shuttle's wait on the pad before launch corresponded significantly with bipod foam loss.

RA analyzed ET Working Group data from Test 7, a test examining factors that may affect performance of the Super Lightweight Ablator (SLA) surrounding the bipod under much of the foam ramp. RA procured bipod heater current data for analysis by the Systems Working Group. Foam defect data from bipod ramp dissection (Tests 4 and 5) were analyzed and findings reported to the Thermal Protection System (TPS) Block Closure subteam and Marshall's S&MA ET team. RA analyzed data from an ET Working Group foam adhesion ("plug pull") test and found that "dry lube" (molybdenum disulfide) may not affect adhesion, but cure time probably does. RA also proved high variability between two sets of test panels, indicating a "lurking variable" playing an important role in this test. This analysis was presented to the ET Working Group.

RA examined foam loss data and looked for patterns and families; a few interesting items were presented to the TPS Block Closure subteam. Most interesting was a finding that there was no difference, according to this limited dataset, between the four orbiters in the number of tile damage areas greater than 1" in size as rated postflight. RA followed test teleconference and reported salient issues to other S&MA personnel. RA lined up DCMC support to examine test article build paperwork. RA followed up on quality issues involving test articles, including a primer application procedure (decision to disassemble and rework) and missing data (good data was identified).

RA helped to assess a model assembled by USA to predict tensile properties of SRB ET Attach Rings (ETARs). It was discovered that an ordinary least squares regression analysis was insufficient to cover this case, in which there was significant variability in the predictor variable (portable hardness reading). Several alternative models were identified and analyzed. A calibration curve relating hardness to tensile was agreed on and presented. A similar process is being discussed for splice plates.

RA found a quality issue with a method proposed to be used to measure SRB ETAR Splice Plates. Some team members had asserted that Rockwell hardness measurements had little enough variability to be used without considering that variability. This did not match the analyst's experience. It was also RA located

data, interviewed an ASTM representative and performed an analysis on the data. It was found that the data was in fact quite variable, and that the calibration curve from ASTM A370 proposed to be used was possibly nonconservative. The results were presented to a center Materials and Processes team member, who is reexamining the data. RA is performing additional analyses on data from testing per direction from team leadership.

RA supplied an analysis of delays to launch over the life of the program. It was found that delays are less likely over the last 50 launches than early in the program, but may not have changed since that time. The data will be used for benchmarking Orbital Space Plane (OSP) requirements for Launch Availability.

RA revised MPG 8730.4, Statistical Procedures, to more fully reflect the intent of the AS9100 document. A more central role in planning for the use of statistical analysis and a requirement to document any use of statistics in permanent records were the most important changes. The revised document was presented to the DCB and accepted.

4.7.4 OSP Risk Assessment

To support total program integration of risk management between the OSP Program and the ISS Program, the ISS Risk Management Application (IRMA) used by ISS is being revised and reapplied for OSP. HEI has issued an initial subcontract to Futon, the developer of IRMA for ISS, for implementation at MSFC of IRMA on the OSP Program. This includes software support, technical documentation, training, quantitative risk methods, and technical expertise.

HEI Risk Management PAE has developed a draft risk management plan for the OSP Program. The plan was discussed at a series of meetings of the OSP risk management community and more meetings have been scheduled to perform a more in-depth review of the plan to define all the characteristics of the plan for the various program elements.

5.0 COST REDUCTION ITEMS

Our continuing cross-utilization of employees, continuous analysis of work in progress to assure that application of resources meets the needs of the task, and the judicious acquisition and distribution of tools to enhance the efficiency of all team members allow us to minimize cost to the customer.

Attachment Number 1

Personnel Information

Total Contract Personnel - June 2003

| | |
|-----|-----|
| HEI | 117 |
|-----|-----|

| | |
|-------------------------------|----|
| Management | 7 |
| Project Assurance | 18 |
| Industrial Safety | 15 |
| System Safety | 14 |
| Reliability & Maintainability | 9 |
| Risk Assessment | 5 |
| PAC | 8 |
| Quality Assurance | 20 |
| Information Management | 12 |
| Independent Assessment | 9 |

Contract Personnel Turnover

Four Full Time Employees Resigned.
Three Full Time Employees Added.
Two Professional Consultants Added.
Seven Summer Hires Added.

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